Research Article

Ludo Carbon Compound Board Game to Study Chemistry Form 5

Theresa Stanley[1*]

[1] SMK Bandar Tun Hussein Onn 2; treskanny22@gmail.com; 0000-0003-4983-7680
[*] Correspondence: treskanny22@gmail.com; 03-90766753.

Abstract: *Secondary school students in Form Five, taking the KSSM syllabus, study Carbon Compound in Chapter two. The chapter focuses on the five homologous groups' physical and chemical characteristics. Given the length and abstract concept of the content, a game board named Ludo Carbon Compound (LCCB) was developed using the theory of social constructivism, which encourages collaboration during learning. The board game is designed to have five rectangles, each representing the five homologous groups. All rules of the traditional Ludo game are retained except for the part where the students need to answer a question from the stack of game cards to enter a token into play from its yard to its starting square. Each student is given five tokens. Along the path, students who land in spaces labelled "C" are required to answer a question from the stack of question cards. Failing to respond will need them to move two steps back. Students will move the coloured token from the starting square and must move in a clockwise direction around the track given by the number thrown on a die. If a piece lands on a piece of a different colour, the piece jumped upon is returned to its starting square. If a piece lands upon a piece of the same colour, this forms a block. This block cannot be passed or landed on by any opposing piece unless they answer a question from the game cards. A piece can only be moved onto the home square by an accurate throw—the first person to move all four pieces into the home square wins. A survey on the perception and learning effectiveness was conducted on the 24 students who played the board game. The data collected from the study were analysed to show the effect of the board game on perception and learning effectiveness. Besides that, the relationship between gender and learning effectiveness was also investigated. LCCB can be marketed as there is no available board game in the market to study Carbon Compounds besides being an alternative 21st-century activity in the classroom.*

Keywords: board game; carbon compound; secondary school, 21st-century learning.

Figure 1. Ludo Carbon Compound

1. INTRODUCTION

Organic chemistry is one of the topics that require attention as it is a complex topic with a high failure (Triboni & Weber, 2018). Carbon Compound is part of the organic chemistry of the form 5 KSSM syllabus. Chemistry is taken in Form five as an elective subject of STEM by science students. The basis of the topic will cover the five homologous groups of carbon compounds (alkane, alkene, alcohol, carboxylic acid and ester)(MOE, 2022). The Ludo Carbon Compound Board(LCCB) is a type of edutainment game subset of serious games. Edutainment usually is developed for high school students focusing on the topic in the syllabus (Rankin & Sampayo Vargas, 2008). Students need to recall the five homologous groups in aspects of the general formula, functional group, structural and molecular formula, chemical reactions, and physical properties of the five functional groups. These will require the students to attain a large amount of knowledge to answer questions related to the topic. LCCB is one solution proposed to help students connect the five homologue groups. Students can study this topic enjoyably and collaboratively. This allows them to swiftly connect numerous reactions without memorising Field (Farmer & Schuman, 2016). Additionally, when learning takes the form of a game, students can engage a subject in the new method.

2. METHODS & MATERIAL

2.1 Methods

In this qualitative research, the samples were chosen through convenience sampling. The samples consist of 32 Form Five secondary school students from an urban government school in Cheras, Selangor. Of the 32 students, 13 were females, and 19 were males. Students were chosen based on the advancement of the topic in the syllabus, as to play this game, students must have completed the chapter. In a group of five, students will play the game for 40 minutes and then answer a survey question using Google Forms. The rules and regulations of the LCCB are similar to the traditional Ludo, except to move a token students will need to answer a question from the 50 stacks of dual language question cards(English and Bahasa Melayu). Students will move the coloured token from the starting square and must move in a clockwise direction around the track given by the number thrown on a dice. If a piece lands on a piece of a different colour, the piece jumped upon is returned to its starting square. If a piece lands upon a piece of the same colour, this forms a block. This block cannot be passed or landed on by any opposing piece unless they answer a question from the game cards. A piece can only be moved onto the home square by an accurate throw—the first person to move all four pieces into the home square wins.

2.2 Materials

Each student is given five tokens, with different colours representing the different homolog groups(recommended is five students in a group as it will represent the five homologous groups). To move across the board, they are given one traditional dice. The design of the board (figure 1) is illustrated with adobe illustrator. Then it is printed on a: 2x1feet chipboard with Avery white sticker (wrap), which has strong adhesivity and durability. The board finishing is matte laminated and folded in the centre.

3. FINDINGS

LCCB is an example of game-based learning. The game is based on a constructivist theory of the learning (Driver & Oldham, 1986). Social constructivist learning is a collaborative process, and knowledge development is from interactions with culture and society. Social constructivism was developed by Lev Vygotsky (Lloyd & Fernyhough, 1999). Constructivism hypothesises the need to supply learners with the needed resources to establish or official way of solving a problem. This implies

a participatory process in learners interacting with their environment to solve the situation. One of the strengths of game-based learning is its known ability to capture learners' attention and ensure their full participation. The motivating approach of games shifts the learning process towards an innovative and stimulating, towards learners' progression in achieving the learning objective set in the game.

In this study, a Likert-type scale questionnaire was used to identify and collect information regarding the perceptions of students and teachers. The Likert-type scale technique is commonly used in social studies to assess attitudes (Croasmun & Ostrom, 2011). The Likert type scale test has the options to choose from 1 – strongly disagree, 2 – disagree, 3 – neither agree nor disagree, 4- agree, and 5 – strongly agree. The questionnaire has two sections; section one has nine questions. In section one, the survey collects data on students' perceptions and eleven questions regarding learning effectiveness with the game in section two. Section one questions are the adaptation, from the research by (Stojanovska & Velevska, 2018), and the authors have given consent to reuse the questionnaire. The authors' conducted quantitative research on 45 high school students in Macedonia to measure the students' and teachers' perceptions of game-based learning. Section two question in the questionnaire was adopted from the research by (Liu et al., 2021). Their experimental research was on 383 college students in the Southern Region of Taiwan. The study aimed to collect data on the learning effectiveness of a game-based intervention.

3.1 Students' Perception

Table 1: The mean value of each item for the students' perception

	Mean	Median
1. The lesson involving educational games was interesting	4.88	5
2. I have learned something new	4.69	5
3. Educational games helped me to broaden my knowledge regarding Carbon Compound	4.75	5
4. The activities were adequate to the learned material	4.84	5
5. The indicated examples were adequate to the learned material	4.81	5
6. The activities involving educational games helped me clarify misunderstandings about The Carbon Compound	4.91	5
7. The time frame was maintained.	4.69	5
8. I could understand the teacher's explanations easily and clearly and the instructions/rules were easy to follow.	4.75	5
9. All group members were active.	4.47	5

The mean values for all nine items show that students either agree or strongly agree that the use of LCCB helped them in understanding and learn the Carbon Compound topic.

3.2. Learning Effectiveness

Table 2: The mean value of each item for the learning effectiveness

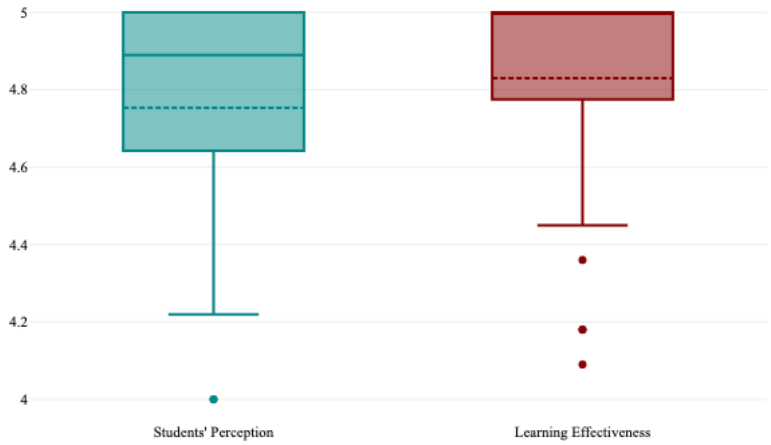
	Mean	Median
1. The "Ludo Carbon Compound Board Game" meets my expectation.	4.75	5
2. The "Ludo Carbon Compound Board Game" helps me understand the Carbon Compound.	4.84	5
3. The "Ludo Carbon Compound Board Game" is useful as an educational tool.	4.88	5
4. The "Ludo Carbon Compound Board Game" can make the lesson more interesting.	4.81	5
5. The "Ludo Carbon Compound Board Game" is worth trying.	4.78	5
6. The "Ludo Carbon Compound Board Game" is meaningful.	4.88	5
7. The "Ludo Carbon Compound Board Game" draws my interest to learning The Carbon Compound.	4.84	5
8. The "Ludo Carbon Compound Board Game" motivates me to learn The Carbon Compound.	4.88	5
9. The "Ludo Carbon Compound' Board Game makes me understand better The Carbon Compound.	4.78	5
10. The "Ludo Carbon Compound Board Game" helps me to learn The Carbon Compound.	4.81	5
11. The "Ludo Carbon Compound Board Game helps me in my studies.	4.88	5

The mean values for all eleven items show that students either agree or strongly agree that the use of LCCB was effective in learning the Carbon Compound topic.

3.3. Statistical Analysis

Table 3: The mean value and Std. Deviation for the learning effectiveness and students' perception

	Students' Perception	Learning Effectiveness
Mean	4.75	4.83
Std. Deviation	0.32	0.29
Minimum	4	4.09
Maximum	5	5



Graph 1: The box plot for learning effectiveness and students' perception

A Pearson correlation was performed to test whether there was an association between Students' Perception and Learning Effectiveness. The result of the Pearson correlation showed that there was a significant association between Students' Perception and Learning Effectiveness, r(30) = 0.64, p = <.001. There is a high, positive correlation between the variables Students' Perception and Learning Effectiveness with r= 0.64. Thus, there is a high, positive association between Students' Perception and Learning Effectiveness in this sample.

Table 4: Strength of correlation

Amount of r	Strength of the correlation
0,0 < 0,1	no correlation
0,1 < 0,3	low correlation
0,3 < 0,5	medium correlation
0,5 < 0,7	high correlation
0,7 < 1	very high correlation

4. DISCUSSION

The developed LCCB has shown a positive perception among 32 Form 5 students who used the game to study Carbon Compounds. They agreed that the game helped them understand the Carbon Compound, can make the lesson more exciting and is helpful as an educational tool that motivates them to learn The Carbon Compound.

5. CONCLUSION

The developed LCCB is one method suggested to teach Carbon Compound for the Form 5 KSSM syllabus. This research is limited to the said topic and the students from one school. Further research can be conducted to test the knowledge retention attained from the game. This can be done through experimental research regarding its effectiveness.

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